海氷融解タイミングが植物プランクトン群集のサイズ組成に及ぼす影響の評価 衛星リモートセンシングを用いたアプローチ

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Assessment of the relationship between timing of sea-ice retreat and phytoplankton community size structure derived from remote sensing in the Bering and Chukchi Sea shelf region

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Extremely high primary production in the shelf region of the Bering and Chukchi Seas supports large biomass of higher trophic level organisms. Not only phytoplankton biomass during spring bloom but also its size structure can affect energy use of higher trophic levels through pray-predator body size relationship. The timing of sea ice retreat should also take into account because it is tightly coupled with timing of spring bloom. In order to assess the influence of sea ice melt timing on phytoplankton community size structure, we investigated inter-annual and spatial variability of phytoplankton community size structure during spring and timing of sea ice retreat using satellite remote sensing.

Satellite remote sensing data used for this study was collected over a period of 1998–2013: remote sensing reflectance (R_{rs}), sea-surface temperature, and sea ice concentration (SIC). Proportion of larger phytoplankton (%Chl$a_{>5\mu m}$) and primary production (PP) were calculated from R_{rs}, and onset date of sea ice retreat was calculated from SIC. Surface heat flux during the sea ice retreat season was also obtained from NCEP/NCAR reanalysis data to infer the variability of mixed-layer depth. We examined pixel-by-pixel relationship between inter-annual variability of phytoplankton parameters (%Chl$a_{>5\mu m}$ and PP) and environmental parameters (SST, onset date of sea ice retreat and surface heat flux) to assess the influence of variability of sea ice retreat timing.

Significant negative relationship between proportion of larger phytoplankton and onset date of sea ice retreat was found for the most part of the shelf region. That is to say, earlier sea-ice retreat causes larger %Chl$a_{>5\mu m}$ in spring. It can be suggested that nutrients were utilized before sea ice retreat by sub-ice algae and/or under-ice phytoplankton bloom in the lately retreated years. On the other hand, we found not only length of ice-free season but also annual mean %Chl$a_{>5\mu m}$ positively correlated with annual net primary production. Thus, both phytoplankton community composition and growing season are important for annual primary production at least in the study area. Our findings would contribute to comprehend the mechanism of recent changings of ecosystem structure in the shelf region.